SC21 Network Research Exhibition

AutoGOLE/SENSE: End-to-End Network Services and Workflow Integration

GNA-G AutoGOLE/SENSE WG

Abstract

The GNA-G AutoGOLE/SENSE WG demonstration will present key technologies, methods and a system of dynamic Layer 2 and Layer 3 virtual circuit services to meet the challenges and address the requirements of the largest data intensive science programs, such as the Large Hadron Collider (LHC) the Vera Rubin Observatory and challenges in many other disciplines. The services are designed to support multiple petabyte transactions across a global footprint, represented by a persistent testbed spanning the US, Europe, Asia Pacific and Latin American regions.

The Global Network Advancement Group (GNA-G) AutoGOLE is a worldwide collaboration of Open eXchange Points and Research & Education networks which delivers end-to-end network services in a fully automated way, wherein connection requests are handled through the Network Service Interface Connection Service (NSI-CS). An increasing number of networks across the globe uses NSI to provision and deprovision international network services, saving a considerable amount of time for NOC engineers to facilitate international network service requests. Provisioning of international circuits is done within minutes, instead of multiple days or even weeks, since manual human interaction is very limited or even zero.

The Software-defined network for End-to-end Networked Science at Exascale (SENSE) system provides the mechanisms to integrate resources beyond-the-network, such as compute, storage, and Data Transfer Nodes (DTNs) into this automated provisioning environment. Key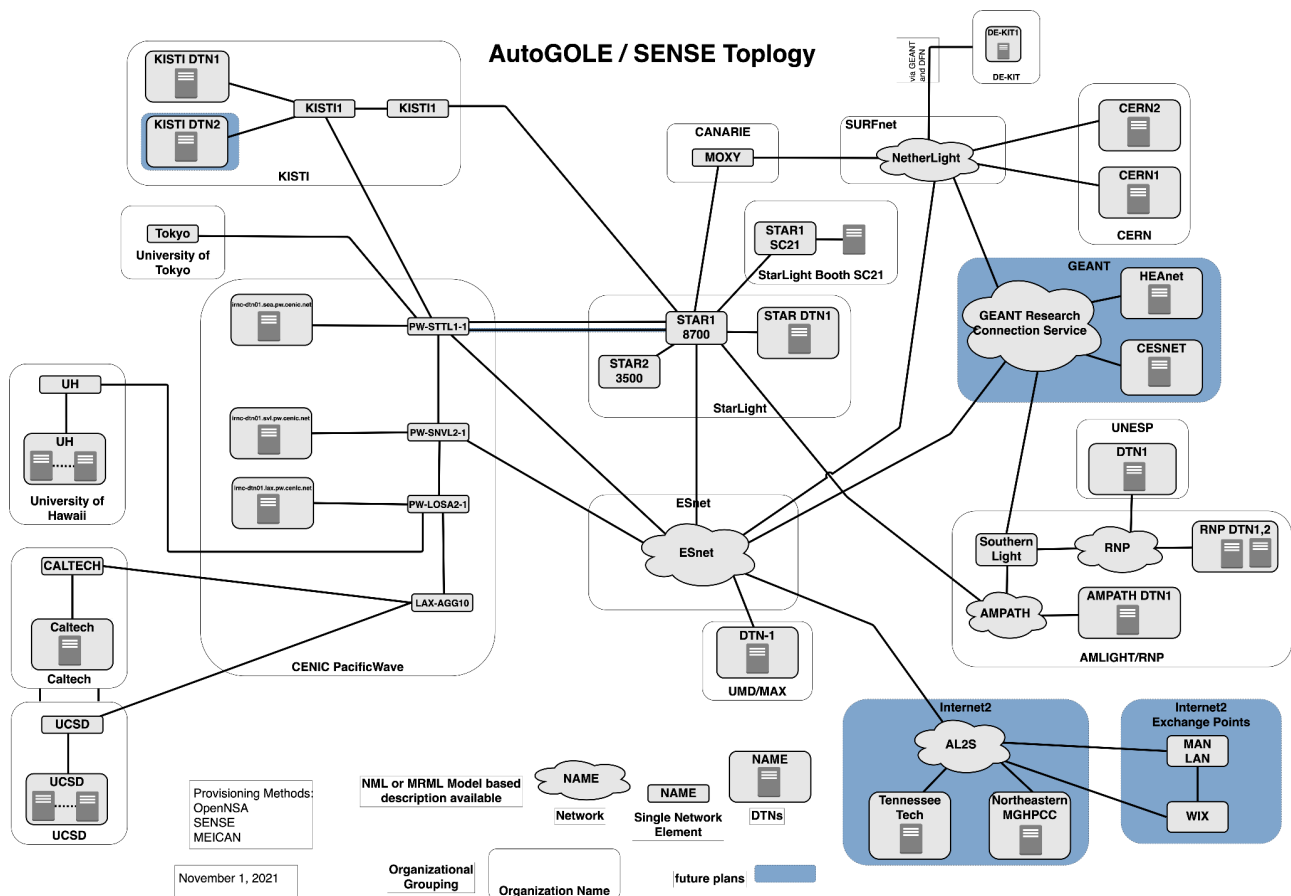 elements of the SENSE architecture, situated between the SDN layer and science program application agents, include an ontological model of the sites and networks, Site and Network Resource Managers and an Orchestrator.

The AutoGOLE/SENSE and Data Intensive Sciences working groups of the Global Network Advancement Group are a collaborative focus on a worldwide scale of R&E network operators and system developers, site software, network and data management system developers and university and laboratory-based scientists in several disciplines.

The combination of these infrastructures, services, and systems enables true "end-to-end" network service provisioning and management. This includes the multidomain network elements AND the network stacks inside the end-systems. The key focus for this work now is to deploy a global scale persistent infrastructure which combines the AutoGOLE and SENSE functionalities to enable complete end-to-end dynamic network services for domain science workflows, and for general use within the Research and Education community.

The AutoGOLE/SENSE infrastructure includes multiple provisioning options including:

- OpenNSA - client tool based on the Network Service Interface (NSI) standard
- MEICAN - graphical user interface enabling collaboration by NOCs across multi-domain infrastructures
- SENSE - model based orchestration system which integrates network and end-system resources into a common provisioning environment.

AutoGOLE / SENSE Toplogy

KISTI DTN1
KISTI DTN2
KISTI1 — KISTI1
KISTI

Tokyo — University of Tokyo

UH — University of Hawaii

CALTECH — Caltech — **Caltech**

UCSD — UCSD — **UCSD**

irnc-dtn01.sea.pw.cenic.net — PW-STTL1-1
irnc-dtn01.svl.pw.cenic.net — PW-SNVL2-1
irnc-dtn01.lax.pw.cenic.net — PW-LOSA2-1
LAX-AGG10
CENIC PacificWave

CANARIE — MOXY
SURFnet — NetherLight
DE-KIT1 — DE-KIT (via GEANT and DFN)

CERN2 — **CERN1** — **CERN**

STAR1 SC21 — StarLight Booth SC21
STAR1 8700 — **STAR DTN1**
STAR2 3500
StarLight

GEANT — GEANT Research Connection Service — **HEAnet** — **CESNET**

ESnet — ESnet

UNESP — DTN1
Southern Light — **RNP** — RNP DTN1,2
AMPATH — **AMPATH DTN1**
AMLIGHT/RNP

DTN-1 — UMD/MAX

Internet2 — AL2S — Tennessee Tech — Northeastern MGHPCC
Internet2 Exchange Points — MAN LAN — WIX

Provisioning Methods:
OpenNSA
SENSE
MEICAN

November 1, 2021

NML or MRML Model based description available

NAME — Network
NAME — Single Network Element
NAME — DTNs

Organizational Grouping — Organization Name

future plans

The AutoGOLE/SENSE demonstration shows how domain science applications can integrate these services into their workflows via API driven information discovery and services provisioning and management. Multiple intercontinental data flows will be shown running across high-performance R&E networks with DTN based endpoints. The AutoGOLE/SENSE infrastructure is shown in the diagram above.

At the campus level, beyond 100G connectivity will be shown at Caltech and UCSD as well as Berkeley Lab (LBL) thanks to the support of CENIC and the use of Ciena Waveserver Ais at Caltech and Los Angeles. This is in addition to 600G of connectivity between LA and the SC21 site and 1200G between StarLight and SC21, and the Pacific Research Platform led by UCSD that includes 400 nodes at 50 universities and labs.

The context of the GNA-G also provides a collaborative focus inter-relating this and several other SC21 Network Research Exhibition demonstrations, bringing together dynamic circuit services, end-to-end monitoring, intelligent data and control planes, and leading edge programmable network operations using P4 to direct and/or shape multiple large flows across intercontinental distances. This is complemented by groundbreaking systemwide decision support software including Reservoir Labs Gradient Graph which is based on a novel mathematical framework, and the NetPredict machine learning optimization software, which are showcased in other NRE submissions.

Goals
The SC21 goal of this experiment is to showcase the global persistent multi-resource infrastructure based on the integration of the AutoGOLE and SENSE functions. In addition, example programmatic driven domain science workflow integration will be shown.

Resources

This NRE demonstration will be conducted using resources of the collaborating domains, see Involved Parties. This will include: Global high-bandwidth links/networks, Data Transfer Nodes, MEICAN, Network Service Interface, and SENSE (Orchestrator, DTN Manager, Resource Manager).

This NRE demonstration will use the AutoGOLE/SENSE infrastructure external to the SC21 in addition to links into the SC21 Exhibit Floor from StarLight in Chicago and CENIC in the Los Angeles area connecting Caltech and UCSD.

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